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Microvertebrates from the Infratrappean Beds of Rangareddi District, Andhra Pradesh and their Biostratigraphic significance

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Abstract

The present paper deals with the microvertebrates recovered from the infratrappean beds of Marepalli and Timsanpalli, Rangareddi District, Andhra Pradesh. The fauna is represented by all the major groups of vertebrates with the exception of mammals and shows affinities to the fauna from the infratrappean beds of Jabalpur and Pisdura, and the intertrappean beds of Asifabed and Naskal. The presence of fish remains of Late Cretaceous age and dental elements of dinosaurs, and the close resemblance of the fauna to that of other known infra-and intertrappean beds which are considered as Late Cretaceous in age favour same age for the investigated sedimentary beds. On the basis of occurrence of an admixture of marine and freshwater faunal elements, a coastal-plain condition of deposition is suggested for these beds.

Introduction

Hislop had done a pioneering work on the infra-and intertrappean fossils of central India as early as in 1860. Subsequently, Woodward (1908) reported fish fossils represented by *Pycnodus lametae*, *Eoserranus hislopi*, *Lepisosteus indicus*, and *Clupea* sp. from the Lameta (=infratrappean) sediments of Dongargaon. Based on these fossils he suggested a Late Eocene age for these beds. Hora (1938) described a number of fish remains from the intertrappean beds of Devthan and Kheri, and suggested an Early Tertiary age for these beds But, later investigations (Jain and Sahni, 1983; Vianey - Liaud *et. al.* 1987) favoured a Late Cretaceous age for these beds. After these initial reports, there was a long gap of work on these beds, till the early part of last decade. The infra-and intertrappean beds are extensively distributed on the eastern, southern and western parts of peninsular India. The fossil content of infra - and intertrappean beds of eastern, southeastern, and western parts of the main Deccan mass was studied by different workers (Hislop, 1860; Woodward, 1908; Hora, 1938; Chiplonkar, 1940; Verma, 1965, Bhalla, 1965 1974; Sahni and Gupta, 1982; Sahni *et al.* 1982; Jain and Sahni, 1983; Rana, 1984; Prasad *et al.* 1986; Prasad and Sahni, 1987). As far as the age of these sedimentary beds is concerned, there are two divergent views, one group of workers suggesting a Tertiary age (Hislop, 1860; Hora, 1938; Sahni, 1934; Bhatia and Mannikeri, 1976; Bande and Prakash, 1982) and the other group favouring a Late Cretaceous age (Blanford, 1872; Rao and Yadagiri, 1981; Sahni, 1983; Jain and Sahni, 1983; Rana, 1984; Prasad *et al.* 1986; Prasad and Sahni, 1985).

In comparison, the infra-and intertrappean beds exposed on the southern margin of the Deccan Traps have remained virtually unstudied. In view of the existing controversies regarding the age of the Deccan

volcanism and associated sedimentary beds, and the significance of the vertebrate fossils in understanding some of these problems, the infratrappean beds of Marepalli and Timsanpalli were chosen for detailed microvertebrate palaeontological investigations.

In Rangareddi District, Andhra Pradesh, Deccan Traps are widely distributed within the Taluq limits of Indur (17°5' : 77°35'), Vikarabad (17° 20' : 77° 55') and Pargi (17° 11' : 77° 53'). They are found at altitudes ranging from 480 to 700 m. Dutt (1975) had reported the presence of seven unweathered Deccan Trap flows and two completely lateritised flows in the present area. These basaltic flows are found associated with both infra - and intertrappean beds at various places. At many localities the infratrappean sediments are underlain by granite and gneiss and are overlain by the trap flow No. 2. Lithologically, these beds are constituted by marls, sandy marls, gritty calcareous marls, and limestones. Some of these infratrappean beds such as those occurring at Marepalli are considered to become intertrappean in position near Timsanpalli, situated about 6 km northwest of Marepalli (Dutt, 1975).

Geological investigations were carried out around Marepalli (17° 20' : 77° 42') and Timsanpalli (17° 21' : 77° 30', Fig. 1) during the summer seasons of 1986 and 1987. Two stratigraphic sections were measured at the above mentioned localities: one situated about 0.25 km SW of Marepalli village and the second one exposed about 1 km NW of the village Tamilsanpalli.

The infratrappean beds of Marepalli are exposed in a quarry section located on the road leading from Marepalli to Jangaon. The sedimentary beds of this section have a total thickness of about 3.75 m. (Fig. 2). The basal unit is represented by a green coloured marl whose base is not exposed at the measured locality, but to the south of Marepalli, the infratrappean beds are found overlying the Archaean granite. The basal green marl is highly rich in microvertebrate remains represented by teeth, scales, postcranial elements of fishes, frogs, crocodyles and dinosaurs. The important findings from this horizon include the fishes : Dasyatidae gen. et sp. indet., *Rhombodus*, *Igdabatis*, *Lepisosteus*, *Pycnodus*, *Phareodus*, *Apateodus*, *Stephanodus*, *Eotrigonodon*, *Indotrigonodon*, Nandidae gen. et sp. indet. Chelonia : carapace fragments; crocodyles: Dyrosauridae gen. et sp. indet., Alligatoridae gen. et sp. indet , and dinosaurs: Hypsilophodontidae gen. et sp indet. The ossiferous horizon is overlain conformably by a hard yellowish white limestone which has yielded fragmentary scales of *Phareodus*. The top most sedimentary unit is a pinkish-white marl lacking in fossils. The uppermost part of the infratrappean sequence is capped by a lateritised basaltic flow which is brick red in colour at the bottom and becomes brownish at the top.

The basal part of the Timsanpalli sedimetary sequence is not fully exposed in the measured quarry section. But, when one moves towards the village Peddamal from Timsanpalli one can see granitic rocks at a lower level. It is, therefore, presumed that the Timsanpalli section is infratrappean in position like the one exposed at Marepalli. The occurrence of similar type of rocks and fauna at both Marepalli and Timsanpalli

further strengthens this view. The basal sedimentary bed of Timsanpalli infratrappean sequence has a thickness of 1.5 m and is mainly composed of coarse, green coloured gritty marl (Fig. 2). This bed has yielded the fishes : *Igdabatis*, *Lepisosteus*, *Pxcnodus*, *Phareodus*, *Apateodus*, *Stephanodus*, *Eotrigonodon*, *Indotrigonodon* anurans; and theropod dinosaurs of *Massospondylus* affinity. The ossiferous horizon is overlain by a fine grained, green marl of 1 m thickness. Overlying the fine grained marl is a bed of 1 m thick pinkish green marl. The basaltic flow, overlying the infratrappean sequence, is lateritised in the basal part and has a pale yellowish-grey colour in the upper part.

Systematic Palaeontology

Class : Chondrichthyes
Order : Batoidea
Family : Dasyatidae
Gen. et sp. indet.
(Fig. 3, E J)

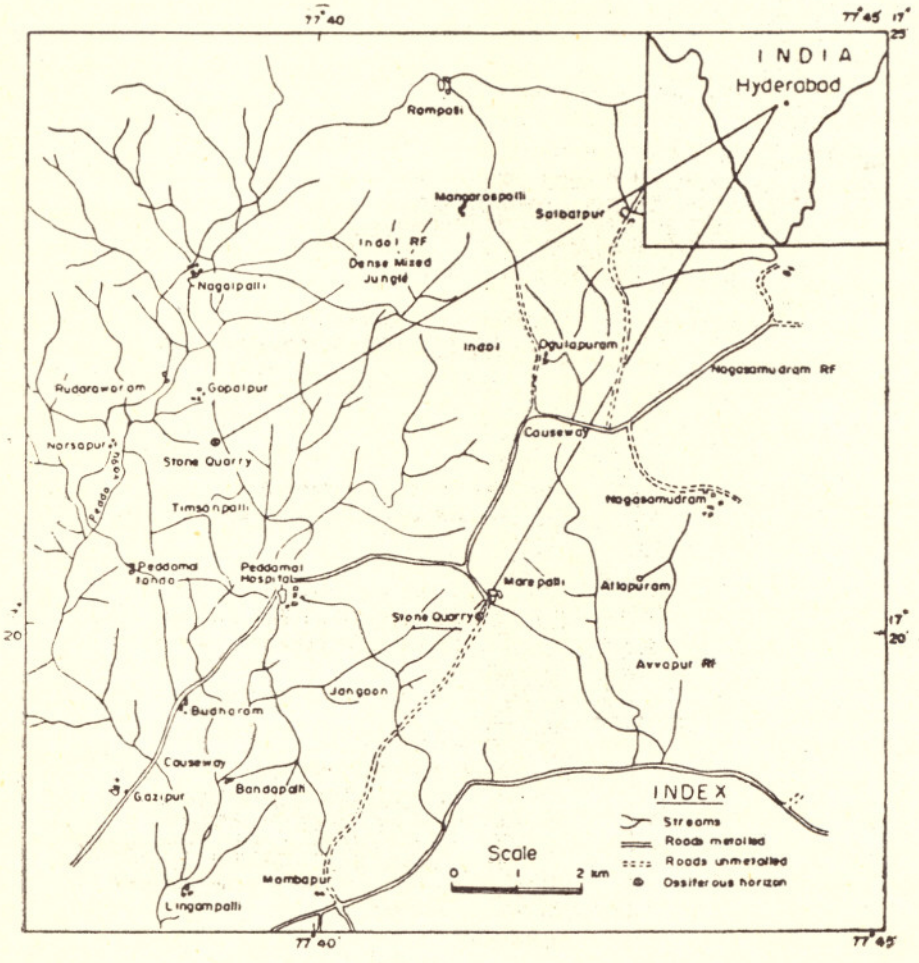

Fig. 1. Map showing the ossiferous localities.

There are a large number of isolated, well preserved teeth in Marepalli fauna, belonging to the family Dasyatidae. These teeth can be divided into four morphotypes.

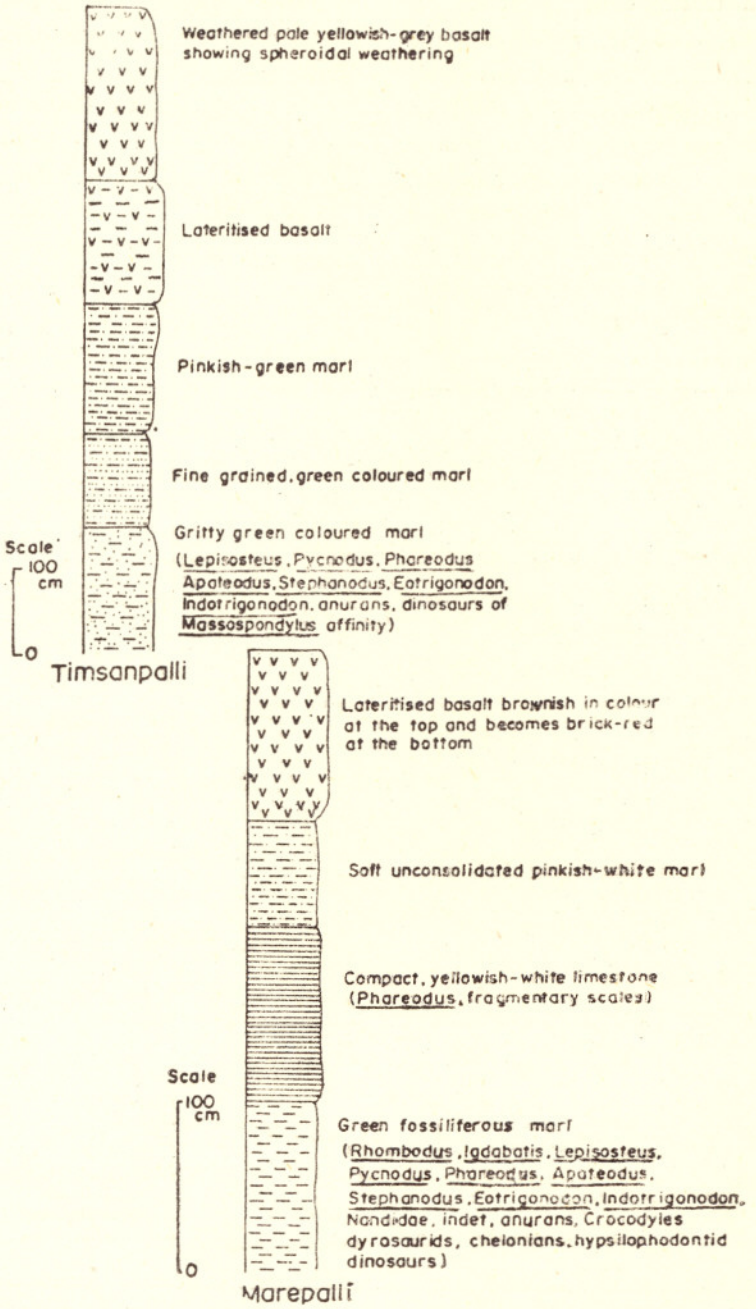

Fig. 2. Stratigraphic columns of the investigated infratrappean sections.

In morphotype-I, the teeth have an oval surface with subrounded to elliptical outline, ornamented with coarse polygonal pits. A transverse ridge separates the occlusal surface of the crown into anterior and posterior parts. The anterior part is slightly slanting anteriorly. The posterior face exhibits a rugose surface. The posterior lip encloses a wide groove which is wider at the lateral ends than in the middle part. There is a slight depression in the posterior middle part of the crown. The root is placed slightly in an inclined position with respect to the crown, outflanking the crown in the posterior view. The root is bilobed or trilobed or the lateral lobes are triangular in outline (Fig. 3, E. F).

The morphotype II is represented by three isolated teeth. The crown in these teeth varies from oval to hexagonal in shape. The anterior and posterior faces are convex in outline. The occlusal surface is ornamented with widely spaced minute pits. The ratio of the heights of crown and root varies from tooth to tooth. The lateral ends of the crown are slightly raised whereas the middle part is slightly depressed. There is a slender, smooth and convex ridge on the posterior side, running all along the width of the tooth. This ridge separates the crown from the root. The root is bilobed and the root lobes are triangular in shape (Fig. 3, G).

A complete and well preserved tooth is placed in morphotype-III. In this tooth, the crown is trapezoidal in outline and is ornamented with coarse irregular pits. A transverse ridge separates the trapezoidal posterior part of the crown from the subcrescentic anterior part. On the anterior part, just below the transverse ridge there is a linear depression. Anterior face of the crown is slightly convex in outline and possesses a median notch. Posterior face is in a straight line. The anterior face is overhanging the root. The posterior lip is very broad and encloses a linear 'U' shaped shallow depression between the posterior crown margin and the lower margin of the lip. On each of the lateral ends of posterior face, there are two distinct articulating surfaces. The root is bilobed with triangular lateral lobes (Fig. 3, H).

Morphotype-IV is represented by an isolated tooth, in which the crown is oval in shape and wider than long. Occlusal surface is highly convex with a pronounced central elevation. From the central ridge, the posterior part of the crown is steeply sloping, whereas on the anterior side, it is sloping gently. Surface of the crown is ornamented with minute irregular pits, but a major part is smooth. There is a large gap between the anterior crown and root, the crown overhanging the root. In the posterior side, the distance between the crown and root is very narrow. In contrast to other teeth, the root is monofid, very small, nearly half the width of the crown. The root is nearly elliptical in outline and is obliquely placed in relation to the crown (Fig. 3, I). In addition to these types of teeth, there are also a few dermal denticles which can be referable to batoids (Fig. 3, J).

All the four morphotypes differ from each other and also other known genera of the family Dasyatidae in above mentioned morpholigical features. It is possible that these forms may represent new genera, but in the

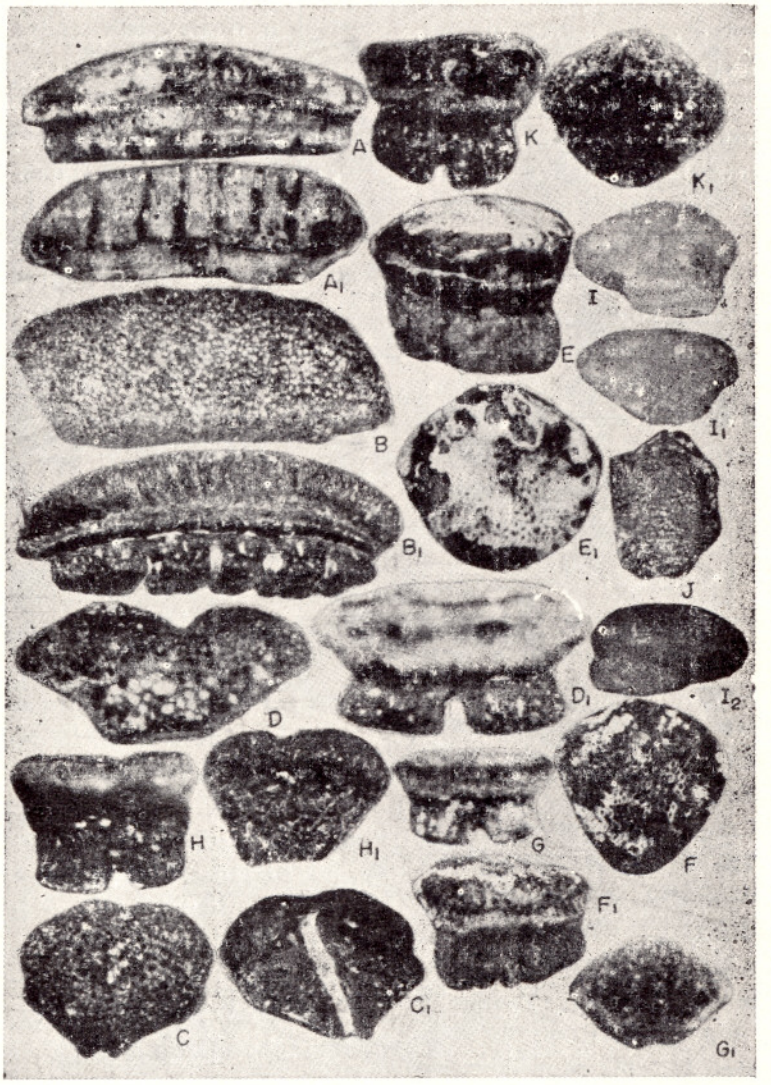

Fig. 3. A-D. Teeth of *Igdabatis* sp. A. median tooth, anterior view x 12. A_1. basal view x 12. B. median tooth, occlusal view x 13. B_1. posterior view x 13. C. lateral tooth occlusal view x 30. C_1. basal view x 30. D. symphyseal tooth, occlusal view x 33. D_1. posterior view x 33. E-I. Teeth of Dasyatidae gen. et sp. indet. E. posterior view x 16. E_1 occlusal view x 16. F. occlusal view x 13. F_1 posterior view x 13. G. posterior view x 26. G_1 occlusal view x 26. H. anterior view x 25. H_1 occlusal view x 25. I anterior view x 30. I_1 occlusal view x 30. I_2. posterior view x 30. J. dermal denticle of Dasyatidae gen. et sp. indet. x 26. K. Tooth of *Rhombodus*, posterior view x 16. K_1 occlusal view x 16.

absence of sufficient fossil and comparative material, it is difficult to say anything at the moment about their taxonomic position at generic and specific level.

Rhombodus sp.

(Fig. 3, K)

There is only one specimen in the psesent collection representing the genus *Rhombodus*. The crown of the tooth is rhombic or diamondshaped as in all the teeth of *Rhombodus*. The posterior part of the crown is much larger in comparison to the anterior part and slanting towards the posterior side. The crown is wider than long. The two regions of the crown are separated by means of two transverse ridges which are alligned parallel to the anterior margin of the crown. The root is higher than crown. Root is divided into two prominent triangular ridges separated by a broad root canal. The middle part of the root is projecting outwards.

Morphological features like rhombic shape of the crown, rugose occlusal surface and reduced height of the crown are characteristic of the genus *Rhombodus*. As such many species of *Rhombodus* have been reported from the Campanian beds of New Jersey and Mexico (Cappetta and Case, 1975), Maestrichtian phosphate beds of Morocco (Arambourg, 1952), Cretaceous beds of Belgium (Herman, 1973) and from the Maestrichtian intertrappean beds of Asifabad (Prasad, 1985). The present specimen is similar in its morphology to *Rhombodus* sp. indet. described by (Prasad, 1985) fron the intertrappean beds of Asifabad (Pl. 10. Fig. 1).

Family : Myliobatidae

Igdabatis sp. Cappetta, 1972

There are many lateral and two isolated median teeth in the present collection from Marepalli and Timsanpalli. The isolated median teeth are complete, well preserved, and slightly arched in the middle, having maximum thickness in the middle and minimum on the lateral sides. The anterior face is concave and posterior face is convex in shape. The lateral teeth are also well preserved but vary in shape from oval, hexagonal to trapezoidal, and in number of root divisions due to positional variation on the jaw. Occlusal surface exhibits numerous hexagonal and polygonal pits. Roots are divided into many alternative grooves and ridges. The crown is wider than long. In symphyseal teeth the crown is trapezoidal in shape, anterior part of the crown is depressed in comparison to posterior part. Anterior face of the crown exhibits a median notch.

Igdabatis is fairly common in Maestrichtian deposits. It was originally known from the Maestrichtian beds of Mount Igdamn Iullemeden Basin, Niger (Cappetta, 1972). Subsequently, it was reported from the Late Cretaceous Lameta Formation of Pisdura (Jain and Sahni, 1983), Jabalpur (Courtillot *et al.*, 1986) and the Intertrappean beds of Asifabad (Prasad *et al.* 1986). The specimens from Mount Igdam, Jabalpur, and Pisdura are more robust in out look. Most of the specimens in the present collection, particularly lateral teeth are remarkably similar to those of the Asifabad intertrappean beds (Prasad and Sahni, 1987).

Class : Osteichthyes
Order : Seminotiformes
Family : Semionotidae
(Lepisosteidae)

Fig. 4. A-C. Teeth of *Lepisosteus indicus*, A lateral view x 63. B. lateral view x 22. D-H. scales of *Lepisosteus indicus*. D. internal view x 25. E. external view x 25. F. external view x 8. G. internal view x 24 H external view x 16. I scale fragment of *Phareodus* sp. I external view x 24. I_1 internal view x 24. J. Tooth of *Phareodus* sp., lateral view x 22. V. vertebra of *Phareodus* sp., lateral view x 29. K-L. Teeth of *Pycnodus lametae*. K occlusal view x 24. L. basal view x 66. M. Tooth of *Pycnodus bicresta*, occlusal view x 25. N-O, oral teeth of *Eotrigonodon wardhaensis* N. internal view x 65. O. inner view x 20. Q. oral tooth of *Eotrigonodon jonesi* external view x 31. P_1 - P_5. oral teeth of *Indotrigonodon ovatus*. P_1. inner view x 24 P_2. external view x 28. P_3. internal view x 29. P_4. internal view x 30. P_5. internal view x 29. R-U. pharyngeal teeth of *Siephanodus libycus*, R. lateral view x 30. T. lateral view x 36. U. lateral view x 34. W-Y, Teeth of *Apateodus striatus*. W. lateral view x 30. Y. lateral view x 18. Z. scale of Nandidae gen. et. sp. indet., external surface x 27.

Lepisosteus indtcus Woodward, 1908

(Fig. 4, A-H)

There are a few isolated teeth and well preserved scales in the fossil collection from Marepalli and Timsanpalli. The teeth are conical in shape, and are differentiated into an apical and basal part by a distinct collar or rim. The basal part of the tooth is ornamented by longitudinal striations which disappear at the junction of apical and basal parts. The apical part is covered with a thick shiny enamel. The lateral edges of the crown are not as sharp as in *Apateodus striatus*. The tips of the crown are blunt and acute (Fig. 4, A-C).

The shape of the scales vary from oval, rectangular to rhombic. The rhombic scales belong to lateral line, scales with aval outline belong to the dorsal ridge. The rectangular scales represent the cavbal region. The internal layer of the scale is thicker than the external layer and consists of a ridge like structure arranged obliquely to the axis. External ganoine layer exhibits well marked boundaries surrounded by a distinct peripheralayer (Fig. 4, D-H).

Both the teeth and scales in the present collection have morphological features similar to those of *Lipisosteus indicus* reported by Woodward (1908) from the Lameta Formation of Dongargaon and those from the Takli Formation of Nagpur (Gayet *et al* 1984) and the intertrappean beds of Asifabad (Prasad, 1985). Similar teeth and scales have also been reported from the Lameta sediments of Jabalpur (Tripathi, 1986) and Pisdura (Jain and Sahni, 1983). The genus *Lepisosteus* has an extensive distribution in the Late Cretaceous sediments of North America, Africa, and South America.

Order : Pycnodontiformes

Family : Pycnodontidae

Pycnodus lametae Woodward, 1908

(Fig. 4, K, L)

Nine isolated teeth belonging to *Pycnodus lametae* were recovered from both Marepalli and Timsanpalli. The teeth are well preserved, having a shape ranging from oval, elliptical to subtriangular. The teeth are broader than long. Unlike in *P. bicresta* the margins of the crown are widely spaced leaving a broad occlusal depression in between them. The base of the tooth is characterised by a hollow basisn without any distinct root. The occlusal surface is a shallow depression with coarse tubercles and crenulated margins.

The morphological features exhibited by the present teeth can be readily traced to *Pycnodus lametae* considered to be a typical Maestrichtian species. *P. lametae* was first described by Woodward (1908) from the Lameta Formation of Dongargaon. Subsequently, it has been reported from the Lameta sediments of Pisdura (Jain and Sahni 1983), intertrappean beds of Nagpur (Rana, 1984) and Asifabad (Prasad and Sahni, 1987). Some of the specimens in the present collection have a smooth appearance which was the result of wearing effects.

Pycnodus bicresta Kumar, 1987

(Fig. 4, M)

There is a single isolated tooth, representing *Pycnodus bicresta*, in the Tlmsanpalli fauna. The tooth is transversely elongated and consists of two transverse ridges on the anterior and posterior sides of the crown.

The margins of the transverse ridges are slightly crenulated. The tooth is wider than long and belongs to the principal series.

The morphological features exhibited by the present specimen are similar to those of *Pycnodus bicresta* reported from the Late Cretaceous intertrappean beds of Nagpur (Rana, 1984) Asifabad (Prasad and Sahni, 1987) and the Middle Eocene Subathu Formation of Jammu and Kashmir (Kumar, 1983). *P. bicresta* is a long ranging form extending from the Late Cretaceous to Middle Eocene.

Order : Osteoglossiformes
Family : Osteoglossidae
Phareodus sp.
(Fig. 4, I, J, V)

At both Marepalli Timsanpalli, a few teeth, a large number of scale fragments and vertebrae belonging to the genus *Phareodus* were found. The teeth are complete and conical in shape with a slight curvature. In the basal section, the teeth are semicircular in outline. The basal and apical parts are differentiated by a rim. The basal part is 3-4 times greater than the apical part. The apical part is very short and is in the form of a cap. The teeth are not flattened laterally as in *Lepisosteus indicus* or *Apatedus striatus* and the lateral edges are smooth and rounded. The external surface of the teeth is smooth without any ornamentation (Fig. 4, J.)

The scale fragments are tetragonal, rhombic and polygonal in outline. External suface of each scale fragment is ornamented by fine tubercles. Inner surface of the scale is a concave basin, the margins of which are elevated to form a finely crenulated rim. Inner and outer surfaces of the rim are characterised by fine lammellae. Isolated coarse tubereles are also present on the inner surface of some scales (Fig. 4, I).

The teeth and scale fragments of present collection are very close to those known from the intertrappean beds of Naskal (Prasad, 1987), Asifabad, Nagpur and the Lameta Formation of Jabalpur. Similar scale fragments are also known from the Eocene Subathu Formation of Kalakot (Jolly and Bajpai, 1988), the Eocene of Pakistan (Gayet Meunier, 1983), but they are much larger in size.

The family Osteoglossidae was earlier considered to have a lower age limit of Early Palaeocene. Recently, De Muizon *et al.* (1984) proved that it extends into Maestrichtian. This view is now strengthened by the occurrence of *Phareodus* in both infra-and interppean sequences.

Order : Protacanthopterygii
Family : Enchodontidae
Apateodus striatus Woodward, 1901
(Fig. 4, W-Y)

There are six isolated teeth, representing *Apateodus striatus, in* the Marepalli and Timsanpalli collection. The teeth are lanceolate in shape and in basal cross-section, the teeth have a subcylindrical outline. The basal part of the teeth is ornamented by fine vertical striations. The teeth are divided into apical and basal parts by a suture. The position of suture is marked by the disappearance of the basal vertical striations. The suture is slightly bulging outwards. The tips of the crowns are blunt and the lateral edges are very sharp in

the form of a flange, which some times gets interrupted at mid-height of the crown.

Apateodus striatus, was described earlier from the Maestrichtian English Chalk (Woodward, 1902), Lameta sediments of Jabalpur (Tripathi, 1986) and the intertrappean beds of Nagpur (Gayet *et al*, 1984), Asifabad (Prasad and Sahni, 1987) and Naskal.

The present teeth differ from *Lepisosteus indicus* in which the teeth have a conical shape, circular cross-section at the base, blunt lateral masgins on the apical part and almost equal apical and basal parts.

Order : Perciformes
Family : Nandidae
Gen. et sp. indet.
(Fig. 4, Z)

Two complete and well preserved isolated ctenoid scales, referable to family Nandidae, were recovered from the infratrappean beds of Marepalli. The scales are subquadrate in shape and are apically rounded. Each scale can be divided into a spiny apical margin, the nucleus region and the basal part characterised by circular striae and radii.

Cycloid and cetnoid scales have so far been recovered from the intertrappean beds of Devthan and Kheri (Hora, 1938). The present scales differ from the scale described under the family Pristolepidae by Hora (1938) in having fairly large nucleus area, basal radii which do not merge with the nucleus, but start from the base of the nucleus and cteneii which are not numerous, occurring near the apical margin.

Order : Tetraodontiformes
Family : Trigonodontidae

Stephanodus libycus Dames, 1883
(Fig. 4, R-U)

Based on the external morphology, a large number of pharyngeal teeth from Marepalli has been referred to *Stephanodus libycus*. The teeth are inwardly curved and constitute a basal root and an upper crown. The crown is in the form of a sickle and is covered with a thick transparent enamel. The teeth were compressed laterally. The crown consists of two prominent cusps, the hook-shaped terminal cusp and the small secondary cusp situated at the base of the terminal cusp. There are two morphotypes in the present collection: one type with pronounced slit-like constriction between the secondary and terminal cusps and second type without such constriction.

Stephanodus libycus is a typical Maestrichtian species known from Niger, Morocco, Libya, Tunisia and the infra-and intertrappean beds of peninsular India. The teeth from Marepalli and Timsanpalli can be distinguished from the Asifabad, Nagpur, and Pisdura specimens, in which there is a triangular shelf at the posterior end of the crown extending from the tip of the terminal cusp to the base of secondary cusp. This triangular shelf is completely absent in the present collection of teeth. The present forms are more closer to teeth known from Niger (Cappetta, 1972).

Eotrigonodon Jonesi White, 1943
(Fig. 4, Q)

A few oral teeth which can be referred to *Entrigonodon Jonesi* were recovered from Marepalli. The inner surface of the tooth is concave, where as the outer surface is convex

in outline. Anterior edge is slightly projecting, while the posterior edge is nearly straight and the height/width ratio is approximately 1:3. The base of the tooth is partly missing. The crown is sub-rectangular in outline and has smooth cutting edge. The base of the crown is less wider than the upper part of the crown.

In India, oral teeth of *Eotrigonodon Jonesi* are mainly confined to the Late Cretaceous sediments. It differs from *E, wardhaensis* in having smooth thick cutting edge and a very narrow base. Pharyngeal teeth of this species have been recorded from the intertrappean beds of Duddukuru, Rajahmundary (Bhalla, 1974; Prasad, 1987.)

Eotrigonodon wardhaensis Jain and Sahni, 1983
(Fig. 4, N, O)

Eotrigonodon wardhaensis is represented by four isolated oral teeth in the present collection from Marepalli and Timsanpalli. The teeth are rectangular in shape. The outer surface of the crown is convex and the inner surface is concave in outline. The height/width ratio is 1:3. The oral edges are sharp and slightly crenulated. The base of crown is slightly narrower than the apical part. Feeble vertical striations are present on the crown surface.

The Marepalli and Timsanpalli specimens are closely related in their external morphology to *E. wardhaensis* described by Jain and Sahni (1983) from the Lameta Formation of Pisdura and by Prasad and Sahni (1987) from the intertrappean beds of Asifabad. They differ from *E. indicus* (Lydekker, 1986) *E. Jonesi* (White, 1934) in their shape and ornamentation.

Indotrigonodon ovatus Jain and Sahni, 1983
(Fig. 4, P_1-P_5)

Five isolated oral teeth from Marepalli fauna are referred to *Indotrigonodon ovatus*. The teeth are narrow at the base and laterally expanded in the upper part of the crown giving an oval shape for the tooth. The oral surface of the crown is covered with translucent enamelliod and ornamented with fine vertical striations. The outer surface is convex, whereas the inner surface is concave with a shallow depression The cutting edges are very sharp and finely crenulated. These morphological features are charcteristic of *Indotrigonodon ovatus* described by Jain and Sahni (1983) from the Lameta Formation of Pisdura. Similar teeth are also known to occur in the intertrappean beds of Asifabad (Prasad and Sahni, 1987).

Incertae Sedis
(Fig. 5, A-E)

In addition to the above described fish material, there are certain unidentifiable elements of fish in the Marepalli and Timsanpalli collections such as fin spines (Fig. 5,C-E), vertebrae, and parahyoidal bones (Fig. 5, A,B). In the absence of comparative material, it is extremely difficult to make any comments on their taxonomic position.

Class : Amphibia
Order : Anura
Anura indet.

(Fig. 5, F-H)

Fragmentary maxillae, urostyle, vertebra and phalanges were recovered from both the investigated localities. The maxilla is small with a broad dental ridge. Tooth bearing surface is less broader than the dental ridge.

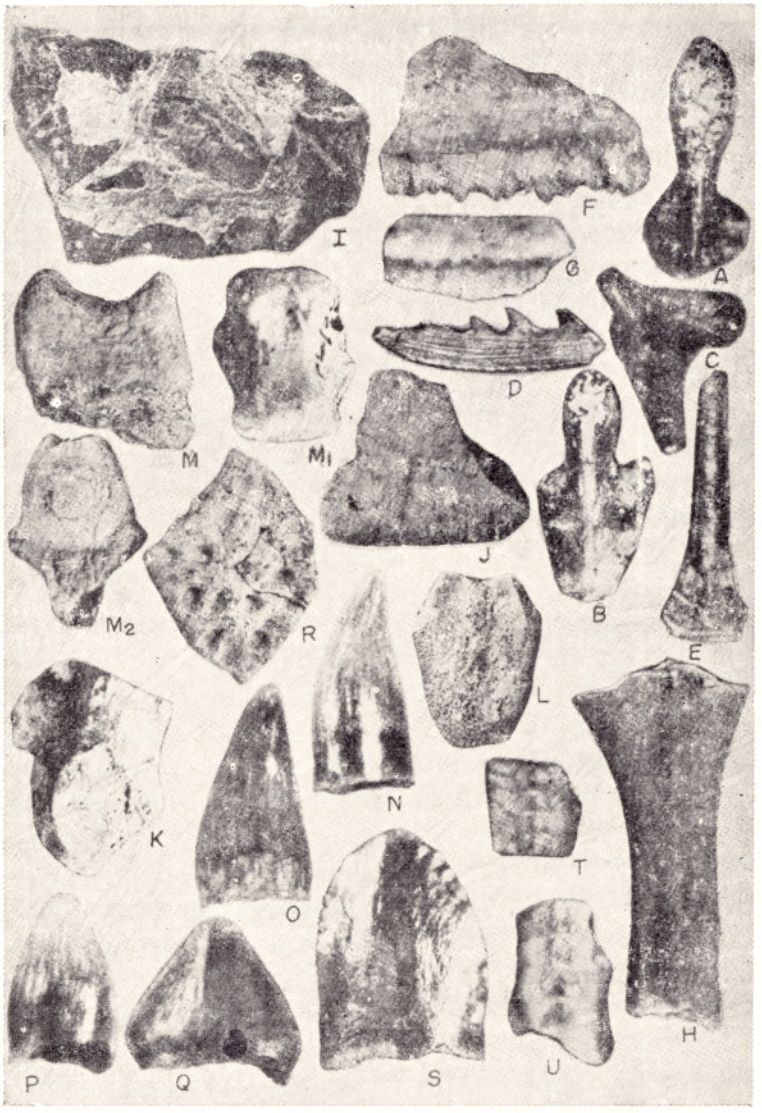

Fig. 5. A-E. Incertae sedis Fish. A. ? parahyoidal bone x 30. B. ?parahyoidal bone x 28. C. spine, lateral view x 25. D. spine lateral view x 25. D. spine lateral view x 22. e. ? spine lateral view x 18. F-H. Anura indet. F. Maxilla, lingual view x 21. G. Maxilla, lingual view x 20. H. urostyle, ventral view x 18. I-L. Chelonia indet. I. Rock specimen with carapace fragments encrusted in it x 0.7. J. carapace fragment x 1. K. carapace fragment x 1. L. neural plate x 1. M. vertebra of Dyrosauridae gen. et sp. indet. M. lateral view x 1. M_1. dorsal view x 1. M_2. anterior view x 1. N-Q. Teeth of Alligatoridae gen. et sp. indet. N-P. anterior teeth. N. lateral view x 13. O. lateral view x 13. P. lateral view x 18. Q. posterior tooth, lateral view x 13. R. Cranial scute of Crocodilia, external view x 1. S. Hysilophodontidae gen. et sp. indet. internal view. 28. T-U. dental fragments of theropod dinosaur cf. *Massospondylus rawesi*. T. lateral view x 21. U. lateral view x 22.

Dorsal surface of the maxilla is broken. There are two complete pleurodont teeth and and nine tooth sockets. Dental gutter is shallow and the tooth bearing surface is very narrow. The dorsal surface is smooth and exhibits only one mental foraman (Fig. 5, F, G). In the anterior face, the urostyle bears two elliptical cotyles. The two cotiles are joined together by a common wall. Dorsal surface of the urostyle is broken whereas the ventral surface is smooth and rounded in outline (Fig. 5, H). There is a single amphicoelous vertebra and a few well preserved phalanges. Since the material is of fragmentary nature, it is not possible to make any comment on their systematic position beyond ordinal level.

Class : Reptilia
Order : Chelonia
Chelonia indent.
(Fig. 5, I-L)

About a hundred fragments of carapace and two neural plates are present in the vertebrate collection from Marepalli. The material available at present furnishes very little as far as their identification at familial and generic level is concerned. From the frequency of their occurrence, it seems they were abundant during their life time.

Order : Crocodilia
Family : Alligatoridae
Gen. et sp. indent.
(Fig. 5, N-Q)

Eight isolated well preserved teeth are present in the microvertebrate fauna of Marepalli and Tirusanpalli. There are two distinct types of teeth. In one type, the teeth are conical, elongated, recurved and their surface is ornamented with longitudinal, fine flutings. These teeth have a round cross section (Fig. 5, N-P). The second type of teeth are more or less triangular in shape and have a smooth external surface (Fig. 5, Q). Due to lateral flattening these teeth exhibit elliptical cross-sections. In addition to these teeth, there are also a few cranial scutes in the present collection (Fig. 5, R). The elongated type teeth are known to occur on the anterior part of the jaw and the broader ones on the posterior part. Similar morphological features are seen in the family Alligatoridae.

Suborder : Mesosuchia
Family : Dryosauridae De stefano, 1983
Ged. et sp. indet.
(Fig. 5, M)

There are two isolated fragmentary vertebrae in the present collection from Marepalli. One of the specimens is well preserved in comparison to the other (Fig. 5, M-O). The vertebra is cylindrical in outline and has a length of 3.0 cm. Although posterior view is completely covered by secondary matrix, it appears to be amphicoelus in nature. The centrum has rectangular outline and slightly depressed concavity in the middle part. Dorsally there is a central depression, the neurocentral suture. Zygapophyses are not visible. There are median projecting processes on the lateral ventral margins of the vertebra On the ventral side, the hypophysis is not visible due to the presence of calcareous matrix.

The present specimens differ from the only record of dyrosaurids from India i. e. from the infratrappean beds of Auspalli (Rana, 1987), in having dorsally projecting neural processes on either end of the vertebra.

Order : Saurischia
Family : Thecodontosauridae
Genus : *Massospondylus*
cf. *Massospondylus rawesi*
(Fig. 5, T, U)

There are two isolated dental fragments in the Timsanpalli collection which can be referred to *Massospondylus rawesi*. These two specimens are the small lateral fragments of the teeth with coarse serrations. The serrations are arranged at an angle to the long axis of the tooth. This type of arrangement is observed in the teeth of *Massospondylus rawesi* known from the intertrappean beds of Nagpur (Lydekker, 1890; Rana, 1984).

Order : Ornithischia
Family : Hypsilophodontidae
Gen. et sp. indet
(Fig. 5, S)

A single isolated and well preserved tooth present in the Marepalli fauna is referable to the family Hypsilophodontidae. The tooth is subcylindrical or subelliptical in outline and laterally compressed. Middle part of the tooth convex and expands outwards. The lateral edges of the tooth are sharp and serrated. The crown surface is smooth. The base is broken and from this end it appears that the root is narrow in comparison to the broader crown. Basal cross-section has an elliptical outline.

The specimen in its small size and shape is very close to those of hypsilophodontid dinosaurs. In the absence of sufficient material, comparison with known genera of the family Hypsilophodontidae is not possible at the moment. In India, hypsilophodontids are known from the Lower to Middle Jurassic Kota Formation, Adilabad District Andhra Pradesh (Prasad, 1986), and from the Maestrichtian Lameta Formation of Jabalpur (Tripathi, 1986).

Age of the sediments

One of the interesting features among the fauna from biostratigraphic point of view is the occurrence of dinosaurian remains such as dental remains of hypsilophodontid and theropod dinosaurs (cf. *Massospondylus rawesi*). Similarly, a close look at the fish fauna recovered from the infratrappean beds of Marepalli and Timsanpalli reveals the presence of a number of Late Cretaceous elements like *Rhombodus*, *Igdabatis*, *Lepisosteus indicus*, *Pycnodus lametae*, *Apateodus striatus*, *Stephanodus libycus*, *Eotrigonodon wardhaensis*, and *Indotrigonodon ovatus*. Since the dinosaurs had become extinct by the end of the Cretaceous, their presence together with the fish fauna can be taken as a conclusive evidence for a Late Cretaceous age of these beds.

From the present study, it is also evident that the vertebrate fauna recovered from the investigated localities shows close morphological affinities to similar fauna known from the Lameta sediments of Pisdura and Jabalpur, and the intertrappean beds of Asifabad, Nagpur and Naskal. The common occurrence of a large number of vertebrate elements both in the infra-and intertrappean beds is in favour of a short interval of time for the deposition of these sediments and stability in ecological niches throughout their deposition.

It is, therefore concluded that the stratigraphic range of the fishes, their affinities to taxa known from the

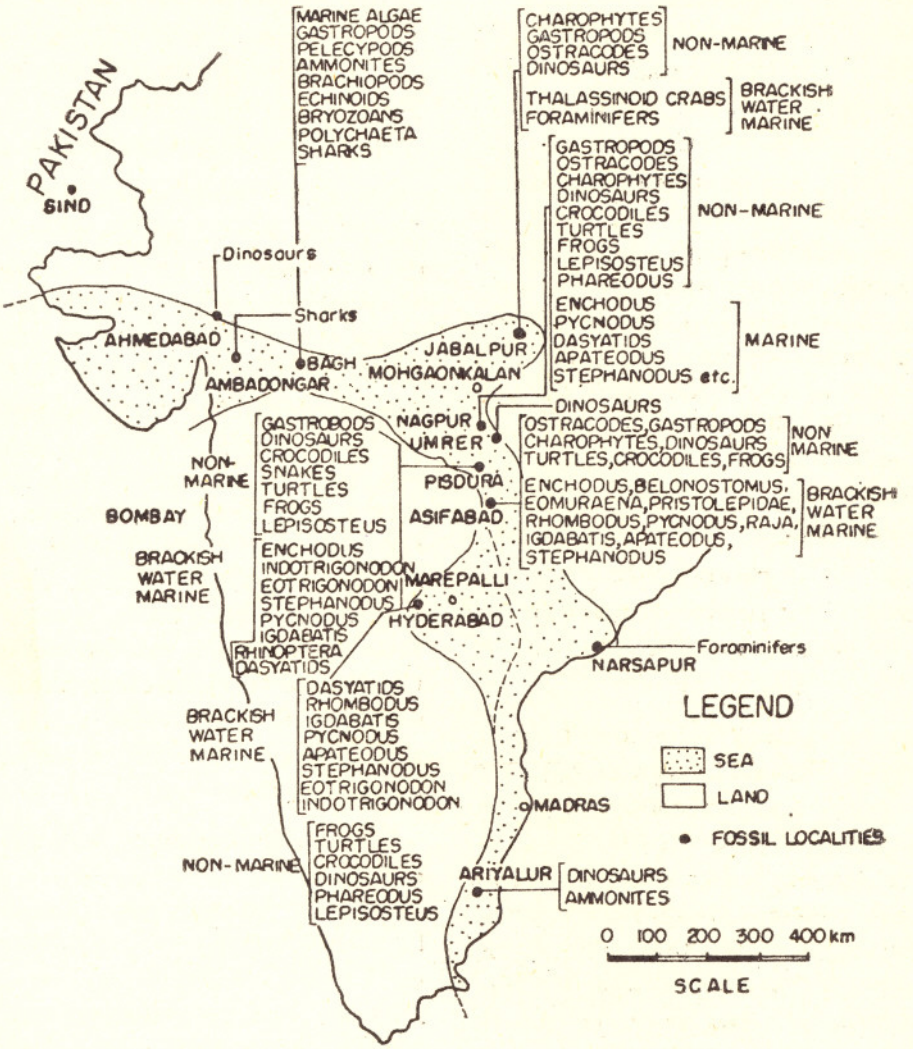

Fig. 6. Palaeogeographic map of paninsular India during Late Cretaceous period (broken lines represent the westren extension of the Trans Deccan Straits Sahni, 1983).

Late Cretaceous formations of peninsular India and the presence of dinosaurs strongly support a Late Cretaceous age for the infratrappean beds of Marepalli and Timsanpalli. The basal basaltic flow overlying the infratrappean sediments was probably initiated in Late Cretaceous times.

Palaeogeographic significance of the fauna

A detailed account on the Late Cretaceous palaeogeography of peninsular India was given by Sahni (1983) and Prasad *et al.* (1986). According to them marine transgressions had taken place along two major axes, the Narbada and Godavari resulting in an epicontinental see connecting the southeast coast of India with the west coast. This epicontinental sea has been named as "Trans Deccan Straits". Their conclusions were based on the faunal and floral elements recovered from the various infra-and intertrappean beds exposed along the Godavari and Narmada axes (Fig. 6). At all the investigated localities they found an admixture of marine and freshwater elements, although the composition is not uniform at all the places. At places they tend to contain more non-marine elements while at other places they tend to be predominantly marine. At Marepalli and Timsanpalli a similar intermixing of marine and non-marine elements occurs but the marine component of the fauna is greater in comparison to the non-marine component. The fauna, like that of Asifabad intertrappean beds suggests a coastal-plain condition of deposition for the sedimentary beds and the presence of a seaway in the proximity of Marepalli and Timsanpalli, thereby extending the western margin of the "Trans Deccan Straits" near to Marepalli and Timsanpall (Fig. 6).

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